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The Status of *Sabellaria spinulosa* Reef off the Moray Firth and Aberdeenshire Coasts and Guidance for Conservation of the Species off the Scottish East Coast

Research Summary

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The Status of *Sabellaria spinulosa* Reef off the Moray Firth and Aberdeenshire Coasts and Guidance for Conservation of the Species off the Scottish East Coast

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Introduction and Methodology

Sabellaria spinulosa is a gregarious tube dwelling marine polychaete that is known to form extensive reef habitats across Europe. The reef habitats formed by *S. spinulosa* represent an important habitat for a variety of marine fauna and are thought to provide ecosystem services including the provision of feeding and nursery grounds for some fish species. *S. spinulosa* reefs have been identified as a priority for protection under the OSPAR Convention for the Protection of the Marine Environment of the North East Atlantic and Annex I of the Habitats Directive, in part due to the recognised decline in this habitat across Europe. Until recently, there was little evidence that this habitat occurred in Scottish waters. However, *S. spinulosa* aggregations with reef-like properties were observed repeatedly between 2011 and 2017 in seabed imagery collected through a variety of sources from the east coast of Scotland. The Scottish Government commissioned this research to assess the conservation status of the newly discovered *S. spinulosa* habitats and to develop guidance for the future management of this habitat on the east coast of Scotland.

Video footage and still images collected from four surveys and ROV clips collected from a fifth, undertaken between 2011 and 2017 (**Figure 1**) were analysed comprehensively in accordance with established National Marine Biological Analytical Quality Control (NMBAQC) methodologies. Reef attributes and associated macrofauna were recorded from each image, ROV clip and video segment (covering an area of approximately 5 m²) and the resulting data were then assessed against existing *S. spinulosa* 'reefiness' criteria developed by JNCC (Gubbay 2007) and Hendrick and Foster-Smith (2006) as well as other more general reef definitions. A new *S. spinulosa* patchiness index developed by JNCC and Cefas (Jenkins, Eggleton *et al.* 2018) was also applied to the data. Finally, comparisons were made between the marine fauna associated with *S. spinulosa* habitats and the surrounding substrata, at each site, as a means of assessing the ecological value of these habitats and how that relates to their relative 'reefiness'.

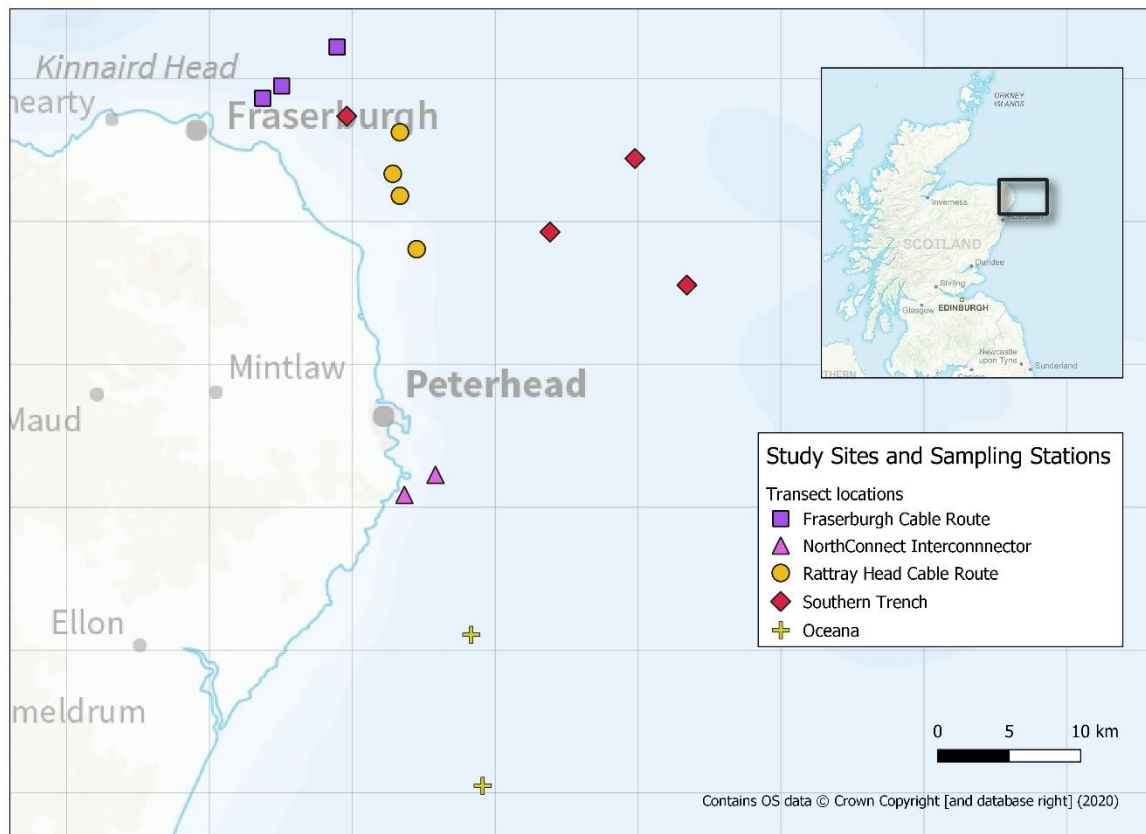


Figure 1. Study sites and sampling stations on the east coast of Scotland.

Results and Conclusions

The Status and Ecological Significance of *S. spinulosa* Reefs on the East Coast of Scotland

This study has identified *S. spinulosa* aggregations at four sites on the east coast of Scotland that would qualify as reef based on the criteria proposed by Gubbay (2007). The best examples of reef were found at the Rattray Head and Southern Trench sites, although the total extent of these features has yet to be established (**Table 1 and Plate 1**). It was only possible to assess the reefiness of *S. spinulosa* aggregations identified from the east coast of Scotland during the Oceana research cruise at the sample level. Although the ROV clips collected were of an exceptionally high standard, they were focused on individual features and were collected using a forward facing angle. It was impossible to assess the proportion of the habitat occupied by these discrete features, or the distance between them using ROV clips alone.

Table 1. Summary of the *Sabellaria spinulosa* reefiness assessments based on the criteria proposed by Gubbay (2007). Reefiness scores are colour coded using the same criteria (red = high, orange = medium, yellow = low). Also shown is the patchiness score ($K p_o/p_r$) calculated using methods developed by Jenkins, Eggleton *et al.* (2018).

Study Site	Stn.	Extent		Elevation		Patchiness		
		Adj. Polygon (m ²)	Video (m ²)	Avg (cm)	Max (cm)	Avg (%)	Max (%)	K (p_o/p_r)
Rattray Head	43 (1)	~	200	5	5 to 10	78	90	1
	45	~	160	5	5 to 10	74	90	1
Southern Trench	STTR01	~	95	6	>10	75	87	1
	STTR04	~	110	3	5 to 10	31	43	1
Fraserburgh	36 (1)	~	80	5	>10	11	61	1
	36 (2)	619,094	90	7	>10	10	66	1
NorthConnect	T04	8,456	85	3	5 to 10	10	45	0.93
	T05	16,848	100	10	>10	17	50	1.37



Plate 1. *Sabellaria spinulosa* reef at Rattray Head

Despite difficulties encountered in analysing the ROV clips obtained during an Oceana research cruise, a new and unique *S. spinulosa* reef sub-type was identified at this location. *S. spinulosa* aggregations in this area are limited in their extent by the available substrate with well-developed reef clumps occurring on isolated cobbles and boulders, in an otherwise fairly featureless soft bottom habitat (**Plate 2**). These reef clumps can be considered analogous to coral reef 'bommies', a term commonly used by divers to describe discrete reef features ranging from a single coral boulder to a large coral reef tower. Bommies are popular with divers because of the diversity and abundance of marine life that they attract. The *S. spinulosa* 'bommies' identified in this study were similarly found to support a high diversity of epifauna including high numbers of the brittle star, *Ophiactis balli*, which was observed living within the crevices of the reef structure itself with only its arms visible from the surface (**Plate 3**).



Plate 2. Newly discovered *Sabellaria spinulosa* reef 'bommie' habitat

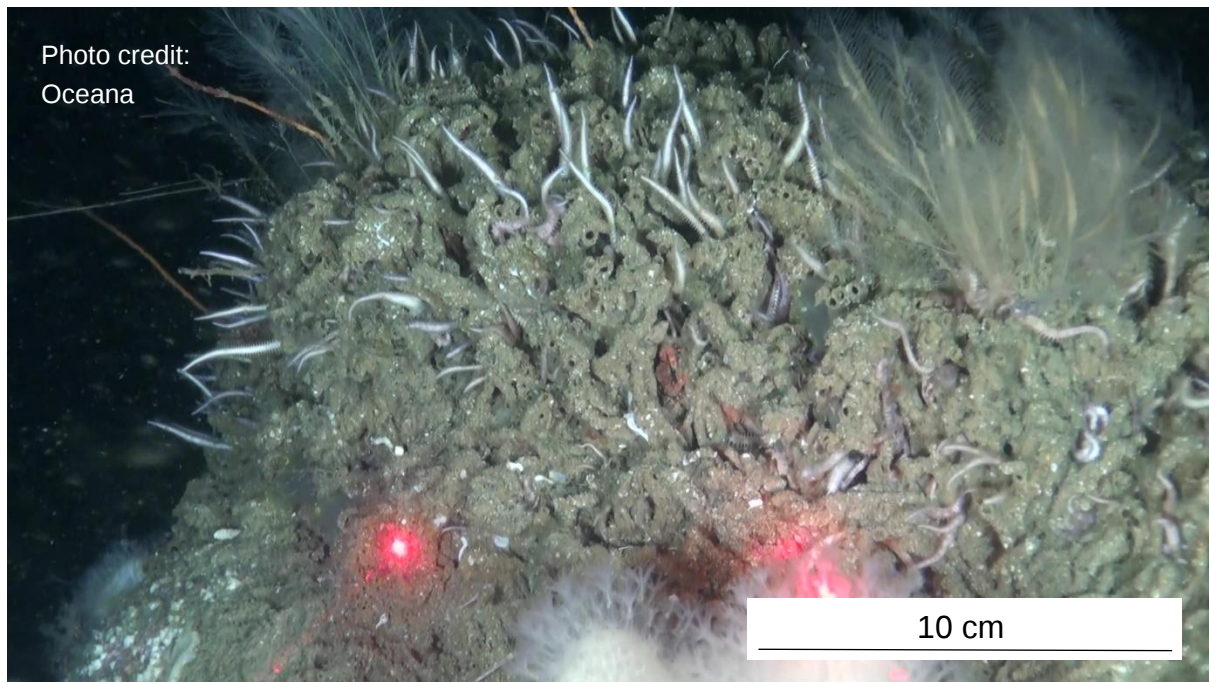


Plate 3. *Ophiactis balli* and other marine fauna living in and on the newly discovered *Sabellaria spinulosa* reef 'bommies'

The influence of *S. spinulosa* reefs on epifaunal communities across the remaining four sites was found to be less pronounced and quite site specific. For the most part, the faunal complement supported by *S. spinulosa* reefs reflected those of the surrounding substrate with slight differences in relative abundance. The same species were seemingly being excluded at one site whilst being more prevalent at another, in the presence of *S. spinulosa* reef. The differences in the influences of *S. spinulosa* reefs between sites is thought largely to be a reflection of the differences in the habitat within which the reefs have developed. At sites where the reefs are surrounded by mixed rocky habitats (e.g. Fraserburgh), epilithic species appear to show a preference for the surrounding habitat. Conversely, where the reef is surrounded by mobile sediments, the reef structure itself may be the only available space for settlement, increasing the abundance of epilithic species.

The overall influence of *S. spinulosa* reefs on the east coast of Scotland was found to be reflected in relatively minor differences in the relative abundance of species that occur in the surrounding sedimentary habitats. There were, however, a small number of species that were found to occur exclusively on the reefs. These included the rugose squat lobster, *Munida rugosa* (**Plate 4 and 5**), the pink shrimp, *Pandalus montagui*, and the brittle star, *Ophiactis balli*. All of these species were found to be inhabiting the crevices or internal structure of the reefs and were most frequently associated with the best examples of reef. High numbers of crevice dwelling crustaceans, including the porcelain crab, *Pisidia longicornis*, have been reported in

association with well-developed reef structures in other areas (Pearce 2008; Pearce, Fariñas-Franco *et al.* 2014; Pearce, Taylor *et al.* 2007; TRC 2019). It has been suggested that such species may make useful indicators for monitoring reef health (Fariñas-Franco, Pearce *et al.* 2014). Although the species were different in this area, they share some ecological functions and occupy the same ecological niche, and therefore they may also have some potential as reef health indicators.



Plate 4. A rugose squat lobster, *Munida rugosa*, found inhabiting *Sabellaria spinulosa* reef at Rattray Head.

Photo credit:
MORL /
FUGRO -
EMU



Plate 5. *Sabellaria spinulosa* reef at Rattray Head¹ and *Munida rugosa*.

The Suitability of Existing ‘Reefiness’ Guidance for Use in a Scottish Context

The existing reefiness guidance performed well on the data collected from the east coast of Scotland, in as much as it identified areas of reef, where the reef-like habitats had been noted by those collecting the seabed imagery and not in footage chosen to represent areas of contrasting habitats. That said, simpler reefiness measures such as the OSPAR reef classification (based solely on % cover), the presence or absence of reef (regardless of whether it was classed as high medium or low) and in some cases, simply the presence of the species itself showed the strongest concordance with the associated epifauna. This indicates that whilst finer grade reef classifications may have benefits from a management perspective they do not necessarily correlate with the ecological value of the reef. This shows good

¹ This image was taken during a benthic survey conducted by Moray Offshore Renewables Limited (MORL). MORL is now referred to as Moray Offshore Windfarm (East) Limited (MOWEL)

agreement with the findings of Pearce, Hill *et al.* (2011) who also found no relationship between the height, patchiness and worm density of *S. spinulosa* reefs on the Norfolk coast and the associated macrofaunal diversity.

Estimating the elevation of *S. spinulosa* aggregations proved to be quite inaccurate, with different assessors often assigning different height classes to the same image or video segment. This led to the development of a reefiness height guide, which did improve consistency, although it did not remove subjectivity completely. Since height was only ever included in the Gubbay criteria because of the need for the feature to be topographically distinct (as defined by OSPAR (2008)) and studies (including this one) have now demonstrated that there is no relationship between reef height and ecological function (Pearce, Hill *et al.* 2011), there is perhaps an argument for simplifying the reefiness classification and only using height to differentiate between reef and non-reef habitats. Reef height also seems to be heavily influenced by the prevailing hydrodynamic regime, with offshore reefs rarely exceeding 10 cm, in contrast to reefs in the comparatively sheltered Wash which have been reported to exceed 30 cm in height. Therefore, the conditions under which the reefs have developed should also be considered. The question of elevation is further complicated by the nature of the underlying and surrounding sediments. It is often impossible to tell from seabed imagery alone whether a clump of *S. spinulosa* is growing over a boulder or from a relatively flat seabed. Where *S. spinulosa* reefs develop in a predominantly sandy area, they may also frequently become inundated (Limpeny, Barrio Frojan *et al.* 2011; Pearce, Hill *et al.* 2011) and so the part of the reef visible in a seabed image may vary dramatically from one day to the next.

The percentage cover of *S. spinulosa* at the sample level seemed to correspond well with patterns observed in the associated fauna. This measure of 'reefiness' is also very simple to record with a reasonable degree of accuracy and consistency when using gird overlays on both video footage and still images. Accuracy could be further increased through the use of automated image processing software such as ImageJ as demonstrated by Fariñas-Franco, Pearce *et al.* (2014).

A new measure of patchiness was proposed recently by Jenkins, Eggleton *et al.* (2018) based on the perceived need to differentiate between areas where *S. spinulosa* grows uniformly and randomly everywhere, and areas where it clusters together to form distinct areas of reef. The method is theoretically sound and it did score discrete clumps of *S. spinulosa* surrounded by areas with no *S. spinulosa* more highly than areas where the *S. spinulosa* occurred more intermittently. The method fails to account for video tows that show *S. spinulosa* reef throughout their entirety, as there is no start and end point to the 'patch'. Effectively this meant that

the best examples of reef in this study were not identified as reef using this method. Furthermore, most of the reefs studied here, and indeed those previously studied from offshore environments do seem to be inherently patchy in nature, with pockets of bare substrate intermingled with areas of *S. spinulosa* aggregations of different heights. In this study many of the habitats were assigned to a mosaic of biotopes to reflect this small-scale patchiness. It is unclear whether the apparent propensity of the species to create patchy reefs, as opposed to being more tightly clustered, is its natural growth form, a reflection of the underlying seabed and its suitability for settlement, or a result of many years of intermittent damage by bottom trawling and storm events. Establishing the nature of *S. spinulosa* reefs, in the absence of fishing or other anthropogenic pressures, is therefore considered an essential step in determining the applicability of the new 'patchiness' statistic to this habitat.

In addition to exploring the applicability of the *S. spinulosa* reefiness criteria to the data collected from the east coast of Scotland, the present study also explored *S. spinulosa* reefiness parameters for reefs already protected as part of a Site of Community Interest, or those proposed for designation as such, across Europe (**Table 2**). The total extents of individual *S. spinulosa* reefs are not reported on the Natura Standard Data Forms and hence extents appear inflated where there are several reefs within one MPA, as is the case for the Haisborough, Hammond and Winterton SCI, the Inner Dowsing, Race Bank and North Ridge Sandbanks SCI and the Wash and North Norfolk SCI. Of these, only Race Bank and North Ridge Sandbanks SCI and the Wash and North Norfolk SCI scored highly based on the reefiness criteria proposed by Gubbay (2007). The largest reef extent comes from the Wash and North Norfolk SCI, where there are not only multiple reefs included in the one extent, but the extents themselves have been calculated based on the extrapolation of point data and are therefore likely to be an overestimate of the true reef extent.

The reefiness criteria proposed by Gubbay (2007) was never intended to be an accepted and fully agreed set of thresholds, but rather the starting point for wider discussions and further research. Given that the criteria have not been reviewed since 2007, and a considerable volume of reef data has been collected across the UK in that time, now may be a good time to revisit and update the criteria. Adjusting the extent categories to better reflect the dimensions of known and protected reefs would be one amendment that we would recommend. Improved guidance on how the criteria should be applied would also be beneficial, as there is a real danger as the criteria stand, that where only 'high' reefiness is assumed to be synonymous with reefs of conservation potential, reefs of better quality than those that we are currently protecting are down-graded or even excluded from the HRA process.

Table 2. Summary of the reefiness attributes of *Sabellaria spinulosa* reefs that are either protected or have been recommended for protection across Europe. The reef metrics have been coloured in accordance with the reefiness criteria proposed by Gubbay (2007) where red = High reefiness, Orange = Medium reefiness and Yellow = Low reefiness. Extents marked with an asterisk denote the combined extent of multiple reefs.

Reef / MPA	Designation	Area (m ²)	Height (cm)	Patchiness (% Cover)	Source
Torre Mileto	SCI	89000	5-6	20	TRC (2019)
Brown Bank	Recommended for designation	1016	≤50	>30	van der Reijden, Koop <i>et al.</i> (2019)
Saturn Reef	SCI	375000	10	80-90 (in places)	BMT (2003)
Haisborough, Hammond and Winterton	SCI	880600*	5-10	30-100	JNCC and NE (2010) JNCC (2017a)
Inner Dowsing, Race Bank and North Ridge sandbanks	SCI	15043500*	3.5-8.5		Woo (2008) JNCC (2017b)
The Wash and North Norfolk	SCI	15750000*	1-6.5	25-100	Jessop and Soutt (2006)

Recommendations for the Future Conservation of *S. spinulosa* reefs in Scottish Waters

Sabellaria spinulosa reefs are not currently listed as PMFs in Scotland despite their high conservation status at a European level. There was little to no evidence of any such habitats occurring in Scottish waters when the PMF list was produced (Howson, Steel *et al.* 2012; Tyler-Walters, James *et al.* 2016). Evidence presented in this study, and additional records from the east coast (Moore 2019; Statoil 2015), suggest that there are in fact *S. spinulosa* reefs in Scottish waters, and it is likely that as survey effort associated with the blossoming offshore renewable energy sector increases, that more will be found. Should *S. spinulosa* reefs be deemed to qualify as a PMF following future assessment against the relevant criteria, there would be an increased impetus on regulatory bodies to ensure that this habitat was protected nationally. The habitats importance level during the EIA and HRA process may also increase, although their conservation status should already be clearly recognised as an Annex I habitat and a habitat listed on the OSPAR threatened and / or declining habitats list. Following current efforts to improve the way in which PMFs are protected outside MPAs (SG 2019), it is also possible that such habitats could be afforded some protection from bottom trawling which arguably presents the greatest threat to *S. spinulosa* reef habitats (Gibb, Tillin *et al.* 2014). That *S. spinulosa* reefs are apparently rare outside of the UK makes it all the more important that these habitats are protected in UK waters.

Many of the habitat examples reviewed as part of this study lie within the Southern Trench possible MPA² and may ultimately be managed as part of this designation. However, not all of the examples are incorporated by the MPA boundary and there are now a number of examples of *S. spinulosa* reef habitat occurring in offshore waters (>12 nm from the coast) on the east coast of Scotland (see for example Statoil 2015), which will present additional challenges from a conservation and management perspective.

The reefiness criteria proposed by Gubbay (2007) performed well on the Scottish reefs but it should be noted that, as in reefs elsewhere in the UK, the relative reefiness (high, medium and low) does not correspond well with the ecological value of the reefs and so areas of 'low' reef should not be discounted as having no conservation value, especially in Scotland where examples of this habitat are less common.

² <https://www.nature.scot/possible-nature-conservation-mpa-advice-documents-southern-trench>

The *S. spinulosa* habitat detected during the Oceana cruise is likely to fall short of the minimum % cover and extent to qualify as a reef under the Gubbay criteria. However, more data would be required to confirm this. Regardless of its apparent 'reefiness' score, the *S. spinulosa* colonies were clearly well established and support a faunal compliment that would otherwise not be able to exist in this area. The *S. spinulosa* 'bommies' were also topographically distinct and so meet many of the broader criteria for reef detailed in the Habitats Directive and OSPAR reef definitions. This habitat certainly warrants further investigation and is perhaps best described as a new *S. spinulosa* habitat subtype, which as far as we know is unique to Scotland. An alternative mechanism for protection should also be explored to ensure that this habitat is given due consideration during the EIA process and that its potential conservation value is not overlooked on the basis of extent or patchiness. To this end, we recommend that the habitat be incorporated into the future assessment against PMF criteria, either as part of a broader '*S. spinulosa* habitat' or '*S. spinulosa* reefs and bommies' feature.

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